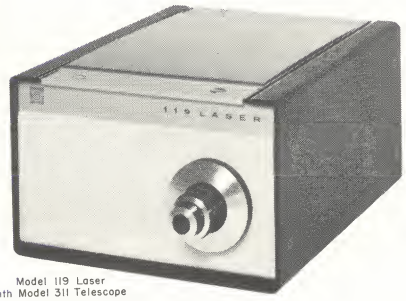
Spectra-Physics

Model 119
Single-Frequency Gas Laser
Data Sheet



Model 119 Laser
with Model 311 Telescope

The Spectra-Physics Model 119 Gas Laser provides intense visible radiation having a high degree of both temporal and spatial coherence. A uniphase, frequency-stable source of optical radiation such as the Model 119 is useful in such applications as long path-difference, fringe-counting interferometry and optical heterodyning. The temporal coherence of the output radiation of the Model 119 is achieved by use of a stabilized optical resonator having a configuration such that only a single mode (transverse and longitudinal) is allowed to oscillate. An optional servo plug-in unit provides additional stability by locking the resonator frequency to the dip* which appears at the center of the doppler-broadened neon emission line of high-gain, CW helium-neon gas lasers.

Specifications

Wavelength — 6328 Å (See Wavelength determination discussion on the reverse side.)

Output Power — Greater than 100 microwatts, uniphase, single frequency.

Long-term Stability — (Output frequency deviation from the center of the neon-twenty emission line, after warm-up and assuming a maximum ambient temperature variation of ±one degree C.)
Without servo control; ±75 MC/day
With servo control; ±1 MC/day

Warm-up — Without servo control;
Three hours maximum from "off" condition.
Thirty minutes maximum from "standby" condition.
With servo control;
45 minutes maximum from "off" condition.
None required from "standby" condition.

Beam Diameter (at $1/e^2$ points) — Approximately one millimeter at laser aperture. (With optional beam collimating telescope; three millimeters.)

Beam Divergence — Approximately 10 milliradians. (With optional beam collimating telescope; <0.3 milliradians.)

External Modulation — Maximum deviation; 1200 Mc peak-to-peak, 10 to 3000 cps; 200 Mc peak-to-peak at 20,000 cps. Modulation sensitivity; ~12 Mc/volt.

Servo FM Deviation — <5 Mc peak-to-peak at a 5 Kc rate.

Repeatability of Servo Lock — Within 5 Mc of Ne^{20} line center.

Input Power — 50/60 cps; 115/230 volts; 250 VA max.

Dimensions — Model 119; 8½" deep x 6¾" wide x 4½" high.
Model 259; 12" deep x 16¾" wide x 5" high.
(Optional brackets provide standard rack mounting)

Weight — Model 119; Approx. 10 pounds.
Model 259; Approx. 25 pounds.

Price — Model 119 Laser and Model 259B Exciter
Without servo option $4,850
With servo option $5,775
Beam collimating telescope accessory
Model 311 (3 mm beam) ..... $ 245
Model 330 (7 mm beam) ..... $ 315

*W. E. Lamb, Jr., "Theory of an Optical Maser," Phys. Rev., Vol. 134, pp 1429-1450; June 15, 1964.

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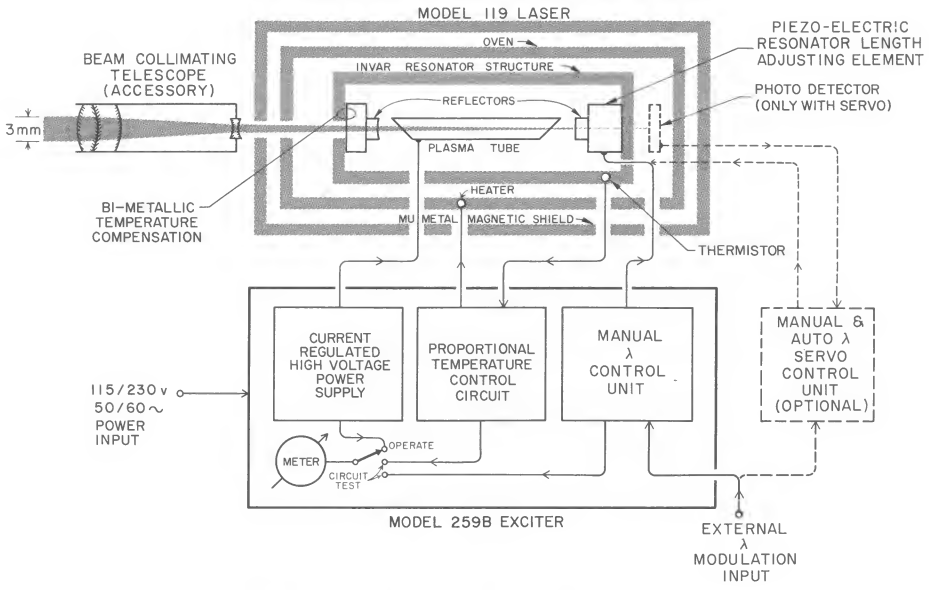

Model 119 System Block Diagram

The Model 119 Laser consists of: a cold cathode dc excited plasma tube containing isotopically pure helium-three and neon-twenty; an invar resonator structure having bi-metallic temperature compensation; and two dielectric resonator reflectors, one of which is mechanically coupled to a piezo-electric element for fine resonator tuning. A photo-detector for monitoring output level is included when using optional servo control. The resonator and plasma tube are contained in a temperature-controlled oven which is further housed in a mu-metal cover to shield the invar resonator from magnetostrictive modulation effects caused by external magnetic fields.

The Model 259B Exciter contains: a regulated dc high-voltage power supply; a thermistor bridge temperature-sensing circuit coupled to a proportional oven temperature-controller; a manual wavelength-control circuit which operates the piezo-electric element; an input for external modulation of laser frequency; and monitoring circuitry providing front-panel meter indication of overall system performance. Provision is also made on the front panel of the Model 259B to allow direct plug-in of the optional Servo Control Plug-In Unit.

Discussion of Wavelength Determination

The output wavelength of the Model 119 Gas Laser has not been compared directly with a primary standard of length. However, it is believed to be very close to a value obtained for a helium-neon laser at the National Bureau of Standards[1]:

$\lambda = 6328.1983$ Å in air at 20°C, 760 torr atmospheric pressure, 59% relative humidity, and 0.03% CO_2,

or

$\lambda = 6329.9146$ Å in vacuum[2].

The Model 119 Gas Laser operates at the center of the emission line of the isotope Ne^{20}, whereas the NBS measurement was made at the peak of the emission profile for natural neon which contains approximately 9% Ne^{22}. Because of isotope shifts, we believe that the Model 119 Gas Laser operates at a wavelength not more than 6 parts in 10^8 longer than the NBS value. However, this estimate is not supported by any measurements and we therefore recommend use of the NBS values pending comparison of the Model 119 Laser with a primary standard.

[1] K. D. Mielenz, H. D. Cook, K. E. Gillilland, and R. B. Stephens, Science 146, 1672 (1964).

[2] For the refractive index of air under various conditions, see National Bureau of Standards Monograph No. 3: Tables of Wavenumbers, or The American Institute of Physics Handbook, 2nd ed., page 6-96 (dry air only).

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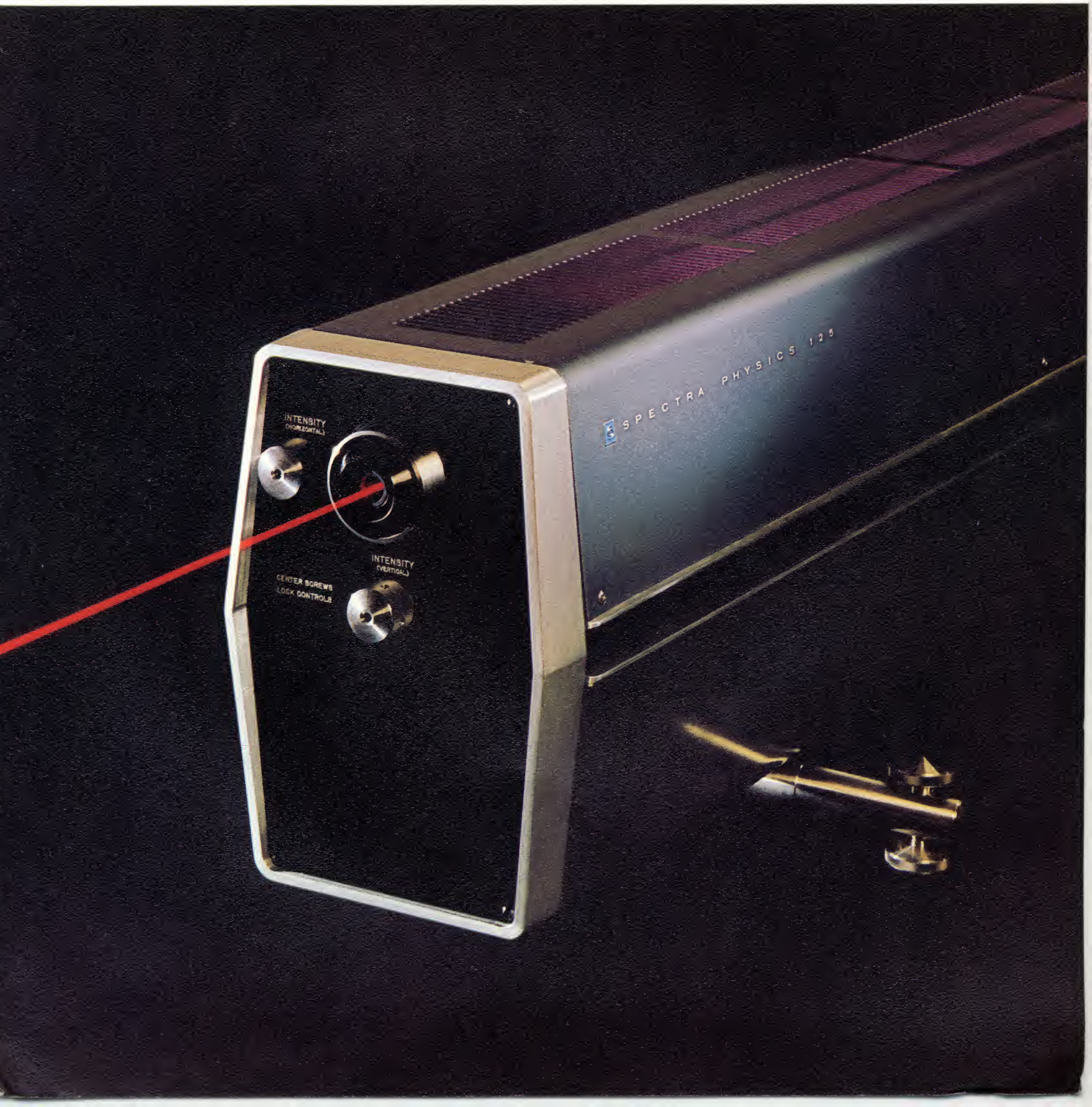
Spectra-Physics Gas Laser Catalog



Gas Lasers from Spectra-Physics

Continuous-wave gas lasers, built by Spectra-Physics have achieved acceptance as primary equipment for every use from simple demonstrations of optical phenomena to the most sophisticated research. Many leading universities, areospace laboratories, government and military research centers, and industrial facilities are using these lasers for investigations and applications in such fields as optical communications, long-path interferometry, plasma diagnostics, propagation studies, optics testing and alignment, precision ranging and velocity determinations, optical tracking, optical data processing, light scattering and photoelastic stress analysis.

In the design of all Spectra-Physics lasers, careful consideration has been given to optimizing the performance, whether it be for an application in research requiring the utmost in performance and versatility, or for a systems application demanding reliable operation under adverse conditions. The superior quality of engineering, materials and construction that is represented by each Spectra-Physics laser product is certified by the unmatched warranty that accompanies each instrument.

WARRANTY: Spectra-Physics gas laser products are unconditionally warranted to be free from defects in workmanship and materials for the first full year following delivery of the equipment. This warranty applies to the plasma tube without regard to operating hours when the plasma tube is excited by the appropriate Spectra-Physics Exciter.

Presented below is a short-form listing of Spectra-Physics gas-laser products. Detailed data sheets are available for each model described here. If your application or research project requires a laser specification not met by our standard models, we invite you to contact our Applications Engineering Department.

Model 131

Model 252

Model 251

The Model 131 is a CW helium-neon laser source designed for a wide variety of uses, with particular emphasis on instrument and systems applications. Design considerations in the unit have been concentrated on compactness, ruggedness, and reliability. For simplicity of operation, dc plasma tube excitation is used with this laser. The unit consists of the laser head which is cable-connected to the separate DC discharge exciter. Provision is made for bolting the laser head to other instrumentation as well as for optical bench mounting; alternatively, it may be operated directly on a table top.

Two DC exciters are available for use with the Model 131 Laser. The Model 252 Exciter is a low ripple, low noise and highly regulated unit with provision for modulation of the output light beam. The lower priced Model 251 Exciter is a rugged and compact unit suitable for use in applications not requiring beam modulation or a highly stable output.

Wavelength	Standard: 6328A (visible red) Optional: 11,523A or 33,912A
Power Output	Hemispherical: 0.75 milliwatt minimum CW from spherical end. (Diffraction limited, uniphase wavefront). Confocal: 1.5 milliwatts minimum CW. (Multiphase wavefront).
Beam Diameter (Hemispherical Resonator)	Approximately 1.2 mm at the exit aperture.
Beam Divergence (at 6328A)	Hemispherical: Collimated to less than 0.7 milliradians (145 seconds of arc) when using supplied collimating reflector. Confocal: Can be collimated to less than 5.5 milliradians (19 minutes of arc).
Weight	Laser Unit: 4 lbs.
	Model 251 Exciter
Ripple	Less than 1%.
Input	115/230 volts, 50/60 cps, 100 va max.
Weight	Approximately 11 pounds.
	Model 252 Exciter
Regulation	$\pm 50\mu a$ (0.5%) with line change of 105 to 125 volts.
Ripple	Less than $5\mu a$ (.05%) rms.
Modulation	Modulation input requires approximately 10.5 volts rms and permits up to 50% modulation of output beam from 10 cps to 100 kc.
Input	115/230 volts, 50/60 cps, 120 va.
Weight	Approximately 14 pounds.
Price	With Model 251 DC Exciter ..... $1,975.00 With Model 252 DC Exciter $2,450.00

Model 130

The Model 130 is an inexpensive, completely portable and self-contained version of the continuous-wave, helium-neon laser. Designed for applications requiring a moderate amount of power, the Model 130 is a reliable, easy-to-use device which requires no adjustment and which may be mounted in any orientation. The performance of this rugged unit is characterized by the same excellence of optical and mechanical quality as well as the reliability found in the other models of the Spectra-Physics product line.

Wavelength	Standard: 6328A (visible red) Optional: 11,523A or 33,912A
Output Power	Hemispherical 0.75 milliwatt minimum CW from spherical end. (Diffraction limited, uniphase wavefront). Confocal: 1.5 milliwatts minimum CW. (Multiphase wavefront).
Beam Diameter (Hemispherical Resonator)	Approxmately 1.4 mm at the exit aperture.
Beam Divergence (at 6328A)	Hemispherical: Collimated to less than 0.7 milliradians (145 seconds of arc) when using supplied collimating reflector. Confocal: Can be collimated to less than 5.5 milliradians (19 minutes of arc).
Weight	13 lbs.
Input Power	115 or 230 volts, 50/60 cps, 90 volt-amperes.
Price	$1,225.00

Model 116

Model 250

The Model 116 has three important features unavailable together in any other commercial gas laser; (1) High uniphase power output (minimum 25 mw at 6328A), (2) Tunability to 8 visible and 7 infrared wavelengths, and (3) High gain, permitting intra-cavity sample losses of up to 15%. These features make the Model 116 a versatile research instrument suitable for a variety of experiments.

Equipment supplied with the Model 116 Laser includes the Model 250 RF-DC Power Supply and 8 interchangeable reflectors to accomplish maximum power output at 6328A, maximum gain at 6328A (for intra-cavity work), wavelength tunability at 8 visible wavelengths, wavelength tunability in the one micron region, and operation at 3.39 microns.

Wavelengths

Visible	Infrared
5939A	1.080 microns
6046A	1.084 microns
6118A	1.152 microns
6294A	1.162 microns
6328A	1.177 microns
6352A	1.199 microns
6401A	3.391 microns
7305A	

High-Gain Intra-cavity loss in excess of 15% permissible at 6328A.

Output Power Diffraction limited, uniphase wavefront

Wavelength	P_{OUT}
6118A	2.0 milliwatts
6328A	25.0 milliwatts
1.084μ	3.0 milliwatts
1.152μ	12.0 milliwatts
3.391μ	3.0 milliwatts

Beam Diameter Approximately 1.0 mm at exit aperture.

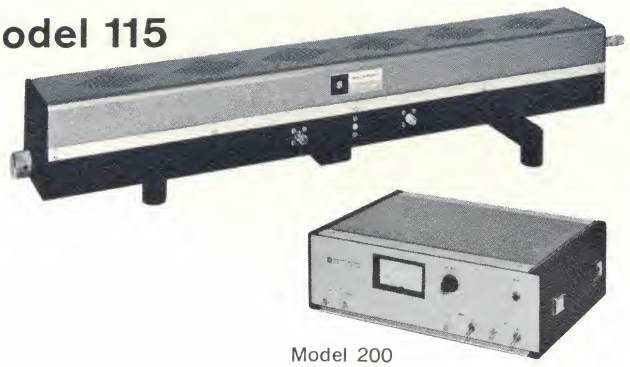
Beam Divergence (at 6328A) Less than 1.0 milliradian (3.5 minutes).

Power Supply 115/230 volts, 50/60 cps,

Weight Laser Unit: 27 lbs., Power Supply: 60 lbs.

Price $9,850.00

Model 115



Model 200

The Model 115 is a precise, versatile, and high performance laboratory instrument ideally suited to a wide variety of experimental applications. Notable performance features of this version of the CW helium-neon gas laser include: stable, noise-free, RF excitation of the plasma; capability of output-beam amplitude modulation; visible or infrared outputs; reflector alignment by precision micrometer adjustments with 1/10th arc second resolution.

Wavelength Standard: 6328A (visible red)
Optional: 11,523A or 33,912A

Output Power Hemispherical 3.0 milliwatts minimum CW from spherical end. (Diffraction limited, uniphase wavefront).
Confocal: 6.0 milliwatts minimum CW. (Multiphase wavefront).

Beam Diameter (Hemispherical Resonator) Approximately 3.5 mm at the exit aperture.

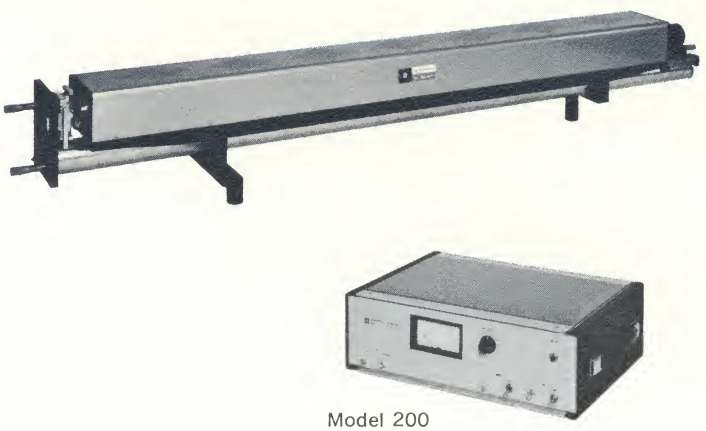
Beam Divergence (at 6328A) Hemispherical: Collimated to less than 0.3 milliradians (60 seconds of arc) when using supplied collimating reflector.
Confocal: Can be collimated to less than 5.5 milliradians (19 minutes of arc).

Power Supply 115/230 volts, 50/60 cps, 300 volt-amperes.

Weight Laser Unit: 8 lbs., Power Supply: 26 lbs.

Price $4,475.00

Model 112



Model 200

The Spectra-Physics Model 112 Gas Laser is a proven, high performance laboratory instrument with a record of reliability and utility in general research applications. Excellent mechanical design for ease of adjustment and stable, high performance operation make the Model 112 a flexible tool for experimentation with coherent light in the visible and infrared regions of the spectrum.

Precision micrometer adjustments of the resonator reflector assemblies mounted on an invar frame allow high-resolution angular and linear movement. Linear separation between reflectors can be resolved to 0.00025 microns. Angular alignment can be resolved to 1/10 arc second. These adjustments, once made, are highly stable and repeatable, not only because of the precision of the adjusting mechanisms, but also due to an invar resonator structure.

The Model 112, a standard among gas lasers, has all of the quality features characteristic of Spectra-Physics instruments: stable, noise-free plasma excitation; capability of output beam modulation; diffraction-limited beam collimation; and mechanical stability which insures a continued high level of performance.

Wavelength Standard: 6328A
Optional: 11,523A, 33,912A

Output Power Hemispherical:
10 milliwatts minimum CW from spherical end.
Diffraction limited, uniphase wavefront.
Long-radius:
30 milliwatts minimum CW.
Multiphase wavefront.

Beam Diameter Approximately 4.5 mm at the exit aperture.

Beam Divergence (at 6328A) Hemispherical:
Collimated to less than 0.24 milliradians (48 seconds of arc) when using supplied collimating reflector.

Power Supply 115/230 volts, 50/60 cps, 350 volt-amperes.

Weight Laser Unit: 35 lbs., Power Supply: 26 lbs.

Price $5,625.00

Model 119

Model 259

The Spectra-Physics Model 119 Gas Laser provides visible radiation having a high degree of temporal coherence at a wavelength of 6328.199A (6329.915A in vacuum).

A uniphase, frequency-stable source of intense optical radiation, such as the Model 119, is useful in such applications as long path-difference, fringe-counting interferometry and optical heterodyning. The high degree of temporal coherence provided in the output radiation of the Model 119 is achieved by use of a thermally stabilized optical resonator having a configuration such that only a single mode (transverse and longitudinal) is allowed to oscillate. An optional servo plug-in unit provides additional stability by locking the resonator frequency to the dip* which appears at the center of the doppler-broadened neon emission line of high-gain, cw helium-neon gas lasers.

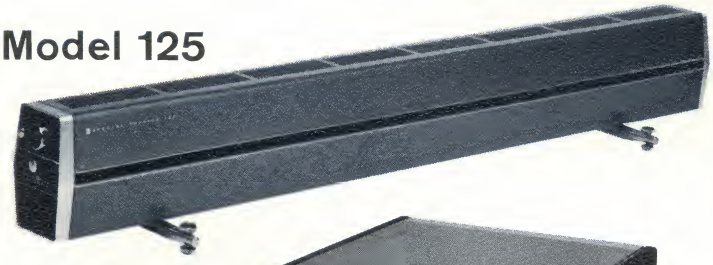
The Model 119 consists of: a dc excited plasma tube attached to a large gas storage reservoir containing isotopically pure helium-three and neon-twenty; an invar resonator structure having bi-metallic temperature compensation; and two dielectric resonator reflectors, one of which is mechanically coupled to a piezo-electric element for fine resonator tuning. A photodetector for monitoring output level is included when using the optional servo control. The resonator and plasma tube are contained in a temperature-controlled oven which is further housed in a mu-metal cover to shield the invar resonator from magnetostrictive modulation effects caused by external stray ac magnetic fields.

The accompanying Model 259 Control Unit contains: a regulated dc high-voltage power supply; a thermistor bridge oven temperature-sensing circuit coupled to a proportional temperature-controller; a fine wavelength-control circuit which operates the piezo-electric element; an input for external modulation of laser frequency; and monitoring circuitry providing front-panel meter indication of over-all system performance. Provision is also made on the front panel of the Model 259 to allow direct plug-in of the optional Servo Control Plug-in Unit.

Long-Term Stability	(Output frequency deviation from the center of the neon emission line, after warm-up and assuming a maximum ambient temperature variation of ± one degree C.) Without servo control ..... ± 75 Mc/day With servo control ..... ± 1 Mc/day
Warm-Up	Without servo control Three hours maximum from "off" condition. Thirty minutes maximum from "standby" condition. With servo control 45 minutes maximum from "off" condition. None required from "standby" condition.
Output Power	Greater than 100 microwatts, uniphase, collimated.
Beam Diameter	Approximately 1.2 millimeters.
External Modulation	Maximum deviation: 1200 Mc peak-to-peak, 10 to 3000 cps; 200 Mc peak-to-peak at 20,000 cps.
Price	Without servo option ..... $4,850.00 With servo option $5,775.00

*W. E. LAMB, JR., "THEORY OF AN OPTICAL MASER", PHYSICAL REVIEW, VOL. 134, PP. 1429-1450; JUNE 15, 1964.

Model 125



Model 250

The Spectra-Physics Model 125 is a high-performance cw helium neon gas laser currently in use and being designed into operational equipment for such applications as optical data processing, information display systems, Raman spectroscopy, atmospheric propagation studies, optical tracking and ranging, and optical communications. The Model 125 is a unique product having such advanced design and performance features as: high cw, uniphase power; wavelength selection; excellent output stability resulting from kinematic resonator mounting and thermal decoupling of the resonator from heat-generating elements; magnetic and optical infra-red super-radiance suppression; dc plasma noise quenching; and a functional prize-winning design.

Output Wavelengths	Standard: 6328A (See Wavelength Selection) Optional: 6118A, 1.084μ, 1.152μ
Output Power (One end only)	Standard: 6328A >50 milliwatts, CW, uniphase Optional: 6118A > 5 milliwatts, CW, uniphase 1.084μ > 5 milliwatts, CW, uniphase 1.152μ >20 milliwatts, CW, uniphase
Beam Diameter	~2.0 millimeters at $1/e^2$ intensity points
Beam Divergence	~0.7 milliradian at 6328A
Resonator Length	1.8 meters
Resonator Adjustments	Precision, orthogonal, vertical and horizontal resonator reflector angle adjustments at both ends of the laser. Adjustment resolution is two arc seconds. (See Wavelength Selection)
Wavelength Selection	An adjustable intra-cavity dispersive element and appropriate optional resonator reflectors provide resonator tuning to the various optional output wavelengths.
Amplitude Stability	Short-term: <1% peak-to-peak, 10 to 100,000 cps Long-term: <3% over three hours assuming an ambient variation of <10°C
Power Supply	Input Requirements: 115/230 volts, 50/60 cps, approximately 450 voltage-amperes. DC Regulation: <±200 microamperes for ±10% line voltage variations.
Weight	Laser Unit: 90 lbs. net. Power Supply: 60 lbs. net
Price	With Model 250 Exciter $8,500.00

For information on price, delivery, and applications or if further technical information or a demonstration is desired, please contact your nearest Spectra-Physics Field Engineering office.

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